Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 6[2] January 2017: 09-15

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.533
Universal Impact Factor 0.9804
NAAS Rating 4.95

ORIGINAL ARTICLE **OPEN ACCESS**

Acaricidal action of Plant Derivatives and Natural oils against two spotted spider mite, *Tetranychus urticae* Koch in Rose (*Rosa sp.*) ecosystem

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ABSTRACT
The field study was conducted during summer 2015 at two different locations i.e., Allanganallur and Vadipatti blocks in Madurai district of Tamil Nadu to evaluate the efficacy of certain promising plant derivatives and natural oils against two spotted spider mites Tetranychus urticae Koch in Rose (Rosa sp.) ecosystem. The cumulative mean data from the present investigation revealed that among the different botanical extracts and natural oils evaluated, Tulsi leaf extract (Ocimum sanctum) @10%, Neem oil (Azadirachta indicia) @ 3% and Nochi leaf extract (Vitex negundo) @ 5% recorded the maximum per cent reduction of mites (71.80%, 71.12% and 70.25% at Vadipatti block and 73.97%, 73.37% and 72.77% at Allanganallur block) respectively, which were statistically on par in their efficacy in Rose ecosystem. With respect to the flower yield; amongst the different plant derivatives and natural oils evaluated, the highest per cent increase in flower yield was recorded in case of Tulsi leaf extract @ 10% (54.31% at Vadipatti block and 54.41% at Allanganallur block), Neem oil @ 3% (53.47% at Vadipatti block and 53.66% at Allanganallur block) and Nochi leaf extract @ 5% (51.68% at Vadipatti block and 53.24% at Allanganallur block) coupled with highest cost benefit ratio of 1:1.86 and 1:1.95 (Tulsi leaf extract @ 10%), 1:1.71 and 1:1.89 (Neem oil @ 3%) and 1:1.66 and 1:1.87 (Nochi leaf extract @ 5%) at Vadipatti block and Allanganallur block respectively which were statistically at par. Consequently in terms of per cent increase in flower yield and cost benefit ratio also, Tulsi leaf extract @ 10%, Neem oil @ 3% and Nochi leaf extract @ 5% were superior than other plant derivatives and natural oils evaluated, which can be presumed as ideal alternative option to synthetic chemical acaricides which are costlier as well for the management of T. urticae in Rose ecosystem.
Key words: *Rose, two spotted spider mites Tetranychus urticae Koch, plant derivatives, natural oils*

Received 01.01.2017 Revised 15.01.2017 Accepted 18.01.2017

INTRODUCTION

Rose, *Rosa sp.,* called as 'queen of flowers' because of its pleasant smell, utility, enchanting sizes, bewitching colours. Its cultivation has become one of the important high value horticultural enterprises in several countries of the world [21]. On the contrary, there are many constraints for qualitative and quantitative production of commercial Rose crop. The major constraint is the invasion of insect and phytophagous mite pests. Among the economic pests of Rose, the two spotted spider mite, *Tetranychus urticae* Koch plays a major role in reducing the flower yield. Mites cause about 53 per cent damage on rose plants with webbed top canopy [2]. Owing to a changing farming scenario as well as climate effects, *T. urticae* has become serious problem upon many crops under both protected and field conditions [1-3]. These mites extensively web the top, fresh growth of leaves and unopened flower buds. Adults and immature stages of *T. urticae* feeds on leaves and flower buds by inserting their stylets into plant tissue, producing tiny silvery spots or yellowing of leaves which later turn brown as a result of which plants become stunted, produce inferior quality of flower buds which fail to open properly and ultimately reduction in yield.

Spraying of synthetic acaricides is in vogue currently for the management of *T. urticae* both in field and protected conditions which could lead to undesirable side effects on environment and non targeted organisms. Hence to overcome the adverse effects of synthetic acaricides, nowadays certain plant derivatives and natural oils have been proved to be effective as suitable alternatives [4, 5]. Consequently keeping the potentiality of plant derivatives and natural oils in view, an attempt was made to evaluate certain plant derivatives and natural oils against *T. urticae* Koch in Rose ecosystem.

MATERIALS AND METHODS

The present study was conducted in field condition during Summer 2015 (March 2015 – June 2015) at two different blocks *i.e.,* Vadipatti and Allanganallur blocks in Madurai district of Tamil Nadu to evaluate the efficacy of certain promising plant derivatives and natural oils such as Garlic bulb extract (*Allium sativum* L.) @ 10%, Nochi leaf extract (*Vitex negundo* L.) @ 5%, Pongamia oil (*Pungamia pinnata* (L.) Panigrahi) @3%, Soapnut extract (*Sapindus marginatus* L.) @10%, Neem oil (*Azadirachta indicia* A. Juss.,) @ 3%, Tulsi leaf extract (*Ocimum sanctum* L.) @ 10%, Fish Oil Rosin Soap (FORS) @ 20%, Horticultural Mineral oil (HMO) @ 2%, Propolis @ 0.75% and Cashew Nut Shell Liquid (*Anacardium occidentale* L.) (CNSL) @ 3% against two spotted spider mite *T. urticae* Koch in Rose ecosystem. The well-known synthetic chemical acaricide (Propargite 57 EC @ 0.1%) was maintained as standard check, besides keeping an untreated check. The present trial was carried out in Randomised Block Design (RBD) with three replications. Three rounds of foliar spray were imposed at forth nightly interval. Before imposing the treatments, the pre treatment count of mites (larvae, nymphs and adults) / leaflet was recorded and the post treatment counts were recorded on 1, 3, 5, 7 and 14 days after each spray. The data collected were analysed statistically using statistical analysis software (*i.e.,* AGRES) and the yield per each treatment and Cost: Benefit economics was also calculated.

RESULTS AND DISCUSSION

From the cumulative mean data of the current study, (Tables 1&2 and Fig. 1&3) it is evident that, among the different botanical extracts and natural oils evaluated, Tulsi leaf extract @10%, Neem oil @ 3% and Nochi leaf extract @ 5% recorded the maximum per cent reduction of mites (71.80%, 71.12% and 70.25% at Vadipatti block and 73.97%, 73.37% and 72.77% at Allanganallur block) which were statistically on par in their efficacy in Rose ecosystem. However the standard check *i.e.,* Propargite 57 EC @ 0.1% was significantly superior to all other treatments evaluated with the highest per cent reduction mite population (89.75% at Vadipatti block and 88.86% at Allanganallur block). Therefore it is presumed that among the different plant derivatives and natural oils evaluated, Tulsi leaf extract @ 10%, Neem oil @ 3% and Nochi leaf extract @ 5% were found superior to other treatments tested in field condition in Rose ecosystem.

Regarding the flower yield (Table 3 and Fig. 2&4), among the different plant derivatives and natural oils evaluated, the highest per cent increase in flower yield was noticed in case of Tulsi leaf extract @ 10% (54.31%), Neem oil @ 3% (53.47%) and Nochi leaf extract @ 5% (51.68%) along with the highest Cost:Benefit ratio of 1:1.86, 1:1.71 and 1:1.66 respectively, which were statistically on par. At Allanganallur block also, the highest per cent increase in flower yield was recorded in case of Tulsi leaf extract @10% (54.41%), Neem oil @ 3% (53.66%) and Nochi leaf extract @ 5% (53.24%) coupled with highest Cost:Benefit ratio of 1:1.95, 1:1.89 and 1:1.87 respectively, which were statistically on par with each other. Nevertheless, the standard check Propargite 57 EC @ 0.1% recorded the maximum per cent increase in flower yield (57.46% at Vadipatti block and 55.90% at Allanganallur block) and cost benefit ratio (1:2.19 at Vadipatti block and 1:2.10 at Allanganallur block) over untreated check. In terms of per cent increase in flower yield and Cost:Benefit ratio also, Tulsi leaf extract @ 10%, Neem oil @ 3% and Nochi leaf extract @ 5% were superior than other plant derivatives and natural oils evaluated in the present investigation, which can be considered as right alternative option to synthetic chemical acaricides which are otherwise too costlier. The present findings are in line with the reports of Aslan *et al.* [6], who found that the tulsi leaf extract @ 10% concentration was very effective against the nymphs and adults of *T. urticae*. Roy *et al.* [7] also reported that 3% leaf extract of *Ocimum tenuiflorum* L. showed acaricidal property against *T. neocaledonicus* Andre which recorded as high as 97% mortality. Premalatha and Chinniah [8] also avowed that *O. Sanctum* recorded the highest mortality of *T. urticae* (74.96% and 78.27 % with reference to eggs and adults respectively), which strongly vouch our present findings.

The bioefficacy of neem oil is in line with the findings of Mridul Sarmah [9], who found that the neem based biopesticide was very effective against red spider mite exhibiting strong acaricidal and growth inhibitory action which is in confirmity with the present findings. Ambika and Chinniah [10] reported that basal application of neem cake in combination with foliar application of *Ocimum sanctum* (10% aqueous leaf extract) recorded the highest reduction of yellow mite population on chilli. Salman *et al*. [11]

reported that, neem oil (3%) caused 80.24% mortality of *T. urticae*. Chauhan *et al*. [12] also reported that the commercial formulations of neem extracts showed significant effect in the control of *T. urticae* on carnation and the population of *T. urticae* in the strategies in which formulations of neem extracts were used was significantly lower than in the untreated check. Ramaraju [13] also proved that neem oil was very effective with 70.56 to 91.85% mortality against *T. urticae* on bhendi. Devi *et al.* [14] reported that Neemazal 0.03% (neem oil) recorded a mean of 12 mites, *O. coffeae* per leaf compared to untreated check (67.50 mites per leaf) after 28 days of treatment. Marcic *et al.,* [15] reported that spraying Neemazal 0.05% resulted in 77.20% reduction of motile forms of European red mite, *Panonychus ulmi* on apple. Sharma *et al.,* [16] found that the Econeem reducing the fecundity and hatchability of eggs of *T. urticae*. Dhananjaya and Nandihalli [17] reported that neem oil was superior in recording the lowest mite population (6.97 mites / leaflet) followed by *V. negundo* (7.18 mites /leaflet) in Rose. Our present findings are also confirms the findings of Onkarappa [18] and Satyanarayana [19] who reported that the neem oil @ 2 % and *V. negundo* (1% and 5%) are very much effective in controlling *T. urticae* in Rose ecosystem. Sugeetha and Srinivasa [20] reported that aqueous leaf extracts of *V. negundo* @ 6% exhibited 76.00 % adult mortality of red spider mites, which is in strong conformity with our present findings.

It can be construed that, even though the efficacy of Plant derivatives and natural oils is not superior to synthetic chemical acaricides, they are moderate in their efficacy in reducing the phytophagous mite population due to their novel modes of action. Therefore Tulsi leaf extract @10% or Neem oil @ 3% or Nochi leaf extract @ 5% may be suggested for the management of *T. urticae* infesting Rose as a suitable alternative to synthetic chemical acaricides due to their eco- friendly and target specific nature. Besides, in a broader sense there is a wide scope for integrating Tulsi leaf extract @10% or Neem oil @ 3% or Nochi leaf extract @ 5% as one of the component in integrated management of acarine pests infesting flowers and other ornamental crops in near future.

Table 1. Field efficacy of plant derivatives and natural oils against two spotted spider mite *T. urticae* Koch in Rose ecosystem. Season - Summer 2015 (Location - Vadipatti Block, Madurai District)

Treatments	Pre treatment count	Mean population / leaflet after				% reduction over untreated check
		I st Spray	II nd Spray	III rd Spray	Cumulative Mean	
T1 - Soapnut extract (*Sapindus marginatus*) @ 10%	24.33	15.78 (3.97)d	13.87 (3.72)d	18.88 (4.35)c	16.18 (4.02)de	55.15
T2 - Garlic bulb extract (*Allium sativum*) @ 10%	24.87	16.00 (4.00)d	14.15 (3.76)d	19.02 (4.36)c	16.39 (4.05)e	54.56
T3 - Pongamia oil (*Pungamia pinnata*) @ 3%	23.91	15.53 (3.94)d	13.52 (3.68)d	18.53 (4.30)c	15.86 (3.98)d	56.03
T4 - Neem oil *(Azadirachta indicia*) @ 3%	24.33	10.72 (3.27)bc	8.17 (2.86)bc	12.36 (3.52)b	10.42 (3.23)bc	71.12
T5 - Nochi leaf extract *(Vitex negundo*) @ 5%	23.98	11.07 (3.33)c	8.49 (2.91)c	12.63 (3.55)b	10.73 (3.28)c	70.25
T6 - Tulsi leaf extract (*Ocimum sanctum*) @ 10%	24.11	10.52 (3.24)b	7.88 (2.81)b	12.11 (3.48)b	10.17 (3.19)b	71.80
T7 - Fish Oil Rosin Soap (FORS) @ 20%	24.14	19.05 (4.37)e	18.55 (4.31)e	20.49 (4.53)d	19.36 (4.40)f	46.31
T8 - Cashew Nut Shell Liquid *(Anacardium occidentale*) (CNSL) @ 3%	24.63	22.43 (4.74)h	26.17 (5.12)h	32.01 (5.66)g	26.87 (5.18)i	25.50
T9 - Propolis @ 0.75%	23.96	20.84 (4.57)g	23.55 (4.85)g	28.01 (5.29)f	24.13 (4.91)h	33.09
T10 - Horticultural Mineral oil (HMO) @ 2%	24.06	19.77 (4.45)f	21.08 (4.59)f	23.94 (4.89)e	21.60 (4.65)g	40.12
T11 - Propargite 57 EC @ 0.1%	24.19	6.76 (2.60)a	2.36 (1.53)a	1.97 (1.40)a	3.70 (1.92)a	89.75
T12 - Untreated check	24.83	29.47 (5.43)i	35.69 (5.97)i	43.04 (6.56)h	36.07 (6.01)j	-
SEd CD (p=0.05) CV%	**NS***	**0.0384 0.0797 1.18**	**0.0510 0.1058 1.63**	**0.0422 0.0876 1.20**	**0.0284 0.0588 0.85**	**-**

* NS – Non significant.

Each value is the mean of three replications.

Figures in parentheses are square root transformed values.

In a column, means followed by common letter(s) is /are not significantly different by LSD at P=0.05%.

Table 2. Field efficacy of plant derivatives and natural oils against two spotted spider mite *T. urticae* Koch in Rose ecosystem. Season - Summer 2015 (Location - Allanganallur Block, Madurai District)

Treatments	Pre treatment count	Mean population / leaflet after				% reduction over untreated check
		I st Spray	II nd Spray	III rd Spray	Cumulative Mean	
T_1 - Soapnut extract (*Sapindus marginatus*) @ 10%	29.19	19.46 (4.41)^{c}	13.11 (3.62)^{d}	14.75 (3.84)^{c}	15.77 (3.97)^{c}	61.84
T_2 - Garlic bulb extract (*Allium sativum*) @ 10%	29.63	19.69 (4.44)^{c}	13.47 (3.67)^{d}	14.97 (3.87)^{c}	16.04 (4.01)^{c}	61.19
T_3 - Pongamia oil (*Pungamia pinnata*) @ 3%	29.87	19.13 (4.37)^{c}	12.80 (3.58)^{d}	14.45 (3.80)^{c}	15.46 (3.93)^{c}	62.60
T_4 - Neem oil *(Azadirachta indicia)* @ 3%	29.96	15.47 (3.93)^{b}	7.86 (2.80)^{bc}	9.70 (3.12)^{b}	11.01 (3.32)^{b}	73.37
T_5 - Nochi leaf extract *(Vitex negundo)* @ 5%	29.33	15.72 (3.96)^{b}	8.12 (2.85)^{c}	9.93 (3.15)^{b}	11.26 (3.36)^{b}	72.77
T_6 - Tulsi leaf extract (*Ocimum sanctum*) @ 10%	29.26	15.26 (3.91)^{b}	7.56 (2.75)^{b}	9.46 (3.08)^{b}	10.76 (3.28)^{b}	73.97
T_7 - Fish Oil Rosin Soap (FORS) @ 20%	29.59	24.07 (4.91)^{d}	17.52 (4.19)^{e}	18.32 (4.28)^{d}	19.97 (4.47)^{d}	51.69
T_8 - Cashew Nut Shell Liquid *(Anacardium occidentale)* (CNSL) @ 3%	29.86	31.35 (5.60)^{g}	27.45 (5.24)^{h}	31.53 (5.62)^{g}	30.11 (5.49)^{g}	27.16
T_9 - Propolis @ 0.75%	29.43	29.75 (5.45)^{f}	26.36 (5.13)^{g}	30.45 (5.52)^{f}	28.85 (5.37)^{f}	30.20
T_{10} - Horticultural Mineral oil (HMO) @ 2%	30.01	28.45 (5.33)^{e}	23.46 (4.84)^{f}	20.27 (4.50)^{e}	24.06 (4.91)^{e}	41.80
T_{11} - Propargite 57 EC @ 0.1%	29.86	8.96 (2.99)^{a}	2.79 (1.67)^{a}	2.06 (1.44)^{a}	4.60 (2.15)^{a}	88.86
T_{12} - Untreated check	29.86	36.04 (6.00)^{h}	40.97 (6.40)^{i}	47.01 (6.86)^{h}	41.34 (6.43)^{h}	-
SEd	**NS***	**0.0520**	**0.0478**	**0.0430**	**0.0471**	**-**
CD (p=0.05)		**0.1079**	**0.0992**	**0.0892**	**0.0977**	
CV%		**1.38**	**1.50**	**1.29**	**1.37**	

* NS – Non significant.
Each value is the mean of three replications.
Figures in parentheses are square root transformed values.
In a column, means followed by common letter(s) is /are not significantly different by LSD at P=0.05%.

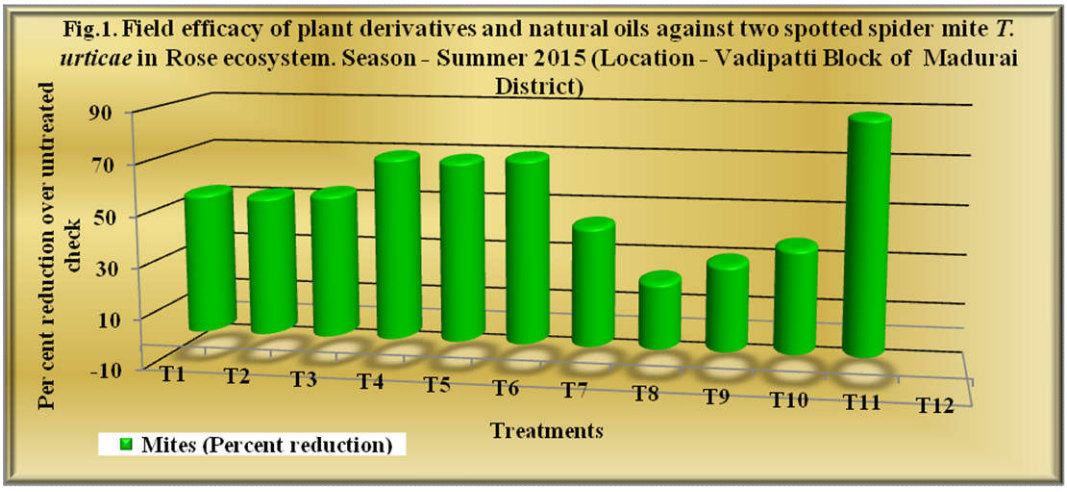
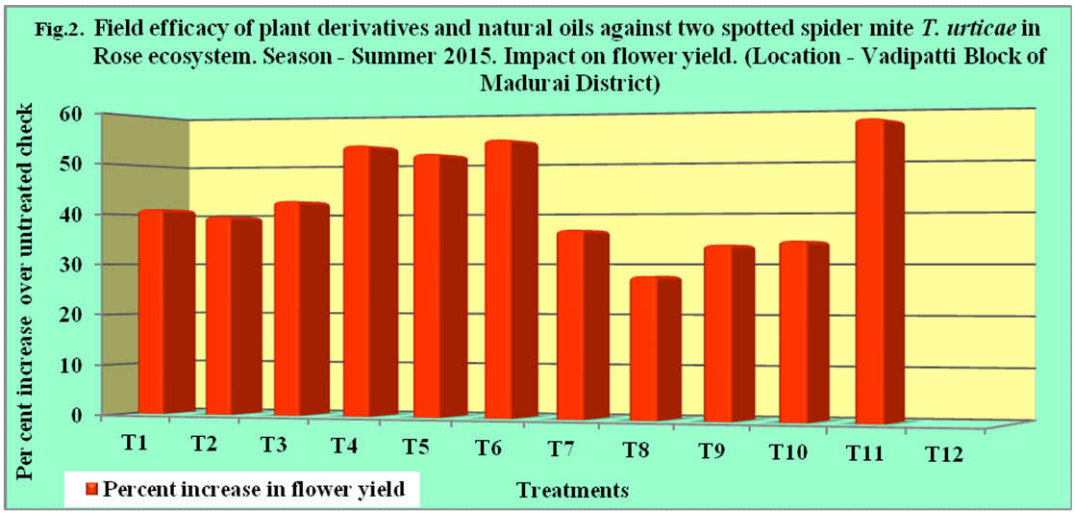
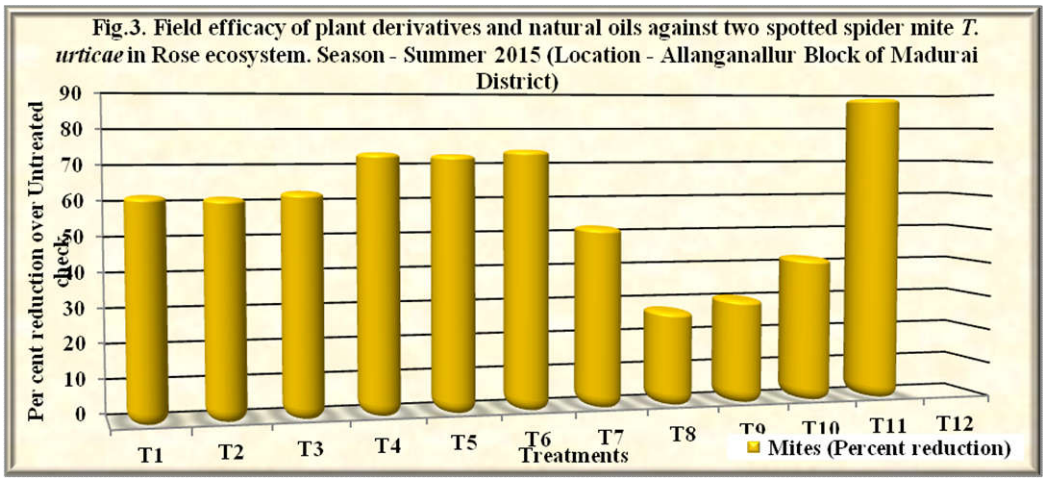


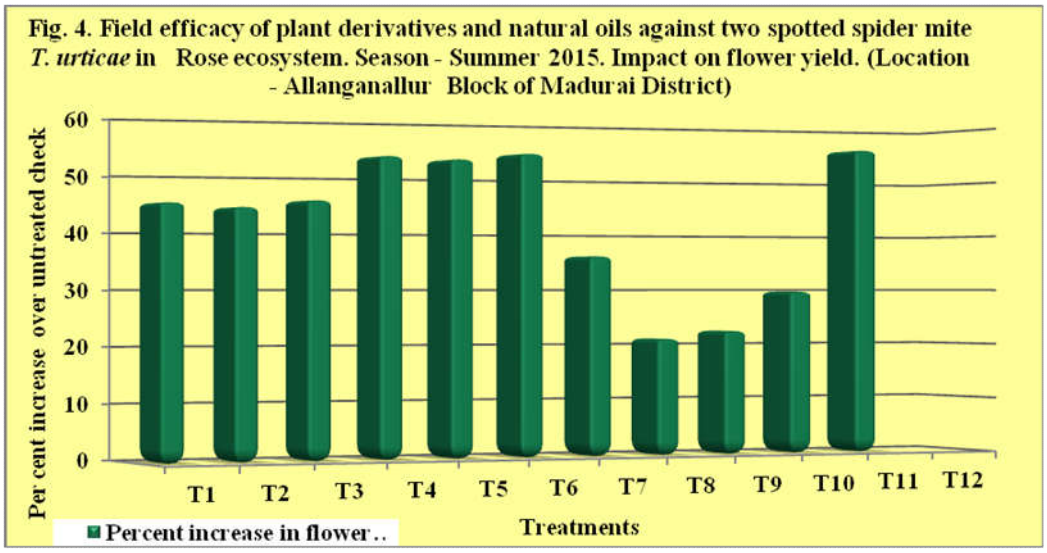
Table 3. Field efficacy of plant derivatives and natural oils against two spotted spider mite *T. urticae* Koch in Rose ecosystem. Season - Summer 2015. Impact on flower yield.

Treatments	Vadipatti Block			Allanganallur Block		
	Flower Yield (t/ha)	% increase over untreated check	C:B ratio	Flower Yield (t/ha)	% increase over untreated check	C:B ratio
T_1 - Soapnut extract (*Sapindus marginatus*) @ 10%	5.13 (0.71)^{de}	41.13	1:1.30	5.65 (0.75)^{c}	45.13	1:1.50
T_2 – Garlic bulb extract (*Allium sativum*) @ 10%	5.00 (0.70)^{e}	39.60	1:1.26	5.58 (0.75)^{c}	44.44	**1:1.43**
T_3 - Pongamia oil (*Pungamia pinnata*) @ 3%	5.26 (0.72)^{d}	42.59	1:1.38	5.71 (0.76)^{c}	45.71	1:1.56
T_4 - Neem oil (*Azadirachta indicia*) @ 3%	6.49 (0.81)^{bc}	53.47	1:1.71	6.64 (0.82)^{b}	53.66	1:1.89
T_5 - Nochi leaf extract (*Vitex negundo*) @ 5%	6.25 (0.80)^{c}	51.68	1:1.66	6.58 (0.82)^{b}	53.24	1:1.87
T_6 - Tulsi leaf extract (*Ocimum sanctum*) @ 10%	6.61 (0.82)^{b}	54.31	1:1.86	6.68 (0.82)^{b}	54.41	1:1.95
T_7 - Fish Oil Rosin Soap (FORS) @ 20%	4.77 (0.68)^{f}	36.69	1:1.19	4.85 (0.69)^{d}	36.08	1:1.28
T_8 - Cashew Nut Shell Liquid (*Anacardium occidentale*) (CNSL) @ 3%	4.18 (0.62)^{h}	27.75	1:1.02	3.93 (0.59)^{f}	21.12	1:1.01
T_9 - Propolis @ 0.75%	4.56 (0.66)^{g}	33.77	1:1.07	4.00 (0.60)^{f}	22.50	1:1.06
T_{10} - Horticultural Mineral oil (HMO) @ 2%	4.61 (0.66)^{fg}	34.49	1:1.12	4.41 (0.64)^{e}	29.71	1:1.10
T_{11} - Propargite 57 EC @ 0.1%	7.10 (0.85)^{a}	57.46	1:2.19	7.19 (0.86)^{a}	55.90	1:2.10
T_{12} - Untreated check	3.02 (0.48)^{i}	-	-	3.10 (0.49)^{g}	-	-
SEd	**0.0082**	-	-	0.0105	-	-
CD (p=0.05)	**0.0170**			0.0218		
CV%	**1.42**			1.80		

Each value is the mean of three replications.
Figures in parentheses are log transformed values.
In a column, means followed by common letter(s) is /are not significantly different by LSD at P=0.05%.







ACKNOWLEDGEMENTS

We express thanks to University Grants Commission (UGC – Government of India) for providing fellowship for perusing Ph.D. degree and Professor & Head, Department of Agricultural Entomology, AC&RI - Madurai (TNAU) for providing necessary facilities in carrying out the present investigation.

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CITATION OF THIS ARTICLE

K.V. Raghavendra, C. Chinniah, K. Ramaraju, C. Muthiah and K. Balakrishnan. Acaricidal action of Plant Derivatives and Natural oils against two spotted spider mite, *Tetranychus urticae* Koch in Rose (*Rosa sp.*) ecosystem. Bull. Env. Pharmacol. Life Sci., Vol 6[2] January 2017: 09-15